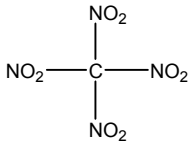
TETRANITROMETHANE
CAS No. 509-14-8
First Listed in the *Seventh Annual Report on Carcinogens*



CARCINOGENICITY

Tetranitromethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals. Mice and rats were exposed to vapors of the chemical in 14-day, 13-week, and 2-year studies. Pulmonary edema in rats and pulmonary inflammation in mice were associated with exposure to the chemical at lethal concentrations. Exposure to tetranitromethane caused a dose-related increase in alveolar/bronchiolar neoplasms to a degree unprecedented in previous NTP studies. Nearly all mice and rats exposed at the top concentrations of 2 and 5 ppm developed alveolar/bronchiolar neoplasms. The incidences of these neoplasms in the low exposure concentration groups (2 ppm for rats and 0.5 ppm for mice) were 66% and 44% in male and female rats and 54% and 48% in male and female mice (NTP 386, 1990). The majority of animals with alveolar/bronchiolar neoplasms had neoplasms diagnosed as carcinomas, and these neoplasms frequently metastasized to a variety of organs. Squamous cell carcinomas of the lung were also markedly increased in rats exposed to 5 ppm. This particular type of neoplasm has been found in only 3 of approximately 1,600 untreated control male rats and in none of a similar number of untreated female controls (NTP 386, 1990).

In an experiment where mice were exposed to 0.2 ppm of 3-nitro-3-hexene by inhalation for up to 15 months, increased incidences of lesions were reported as adenomas and adenocarcinomas of the lung. Hepatocellular carcinomas were found in rats exposed for 6 months to 207 ppm of 2-nitropropane. It appears that inhalation of several small nitrated aliphatic compounds presents a carcinogenic hazard (NTP 386, 1990).

Given the strong induction of lung neoplasms by tetranitromethane, it is noteworthy that no primary nasal neoplasms were seen in the studies. Nonneoplastic lesions in the nasal passage were indicative of chronic irritation. Evidence for inflammatory and regenerative lesions of the nasal cavity and for an absence of neoplasia has also been noted in other recent NTP inhalation studies with irritant chemicals (NTP 386, 1990).

In a pilot epidemiologic study concerning the mutagenic activity of metabolites in the urine of workers exposed to trinitrotoluene (TNT), workers who had been exposed to TNT experienced a higher than expected incidence of stomach cancer (NTP 386, 1990). There are no adequate data available to evaluate the carcinogenicity of tetranitromethane in humans .

PROPERTIES

Tetranitromethane is a colorless to pale yellow, oily liquid with a pungent odor. It is soluble in alcohol and ether but insoluble in water. It is sensitive to heat, friction, and shock. It is prepared by nitration of acetic anhydride with anhydrous nitric acid (Merck, 1989). It is an oxidizer. It decomposes in the prescence of impurities. Tetranitromethane is highly explosive in

the presence of impurities. In addition, tetranitromethane is the principal volatile contaminant of TNT and may constitute as much as 0.12% of the crude material (NTP 386, 1990).

USE

Tetranitromethane is used as an oxidizer in rocket propellants and explosives, and as an additive to increase the cetane number of diesel fuel (NTP 386, 1990). It is also used as a reagent for detecting the presence of double bonds in organic compounds, and as a mild nitrating reagent, reacting with tyrosine residues in proteins.

PRODUCTION

No current estimates of the amount of tetranitromethane intentionally produced have been found in the literature. In Germany during World War II, attempts were made to synthesize large amounts for use as a substitute for nitric acid in rocket fuel. This method, involving the nitration of acetic anhydride with nitric acid, allowed a production rate of up to 10 tons within a few weeks, but was costly. However, by the end of the war, a less-costly method was devised using acetylene and nitric acid, with a reported capacity of 10 kg/day (NTP 386, 1990).

EXPOSURE

The primary route of potential human exposure to tetranitromethane is inhalation. Historically, human exposure to tetranitromethane appears to have occurred during the manufacture and use of TNT (NTP 386, 1990). During the early part of World War I, there was a high incidence of "TNT intoxication" in U.S. and British plants involved in TNT production; an additional step involving washing the crude material with a sodium sulfite solution to hydrolyze the tetranitromethane was introduced to alleviate this problem. Tetranitromethane has been reported to be an atmospheric pollutant emitted as a byproduct of explosives produced in factories owned by the U.S. Government. The estimated "worst case" pollutant level of tetranitrotoluene in the vicinity of the factories was 20 mg/m^3 (about 2.5 ppm). The current time-weighted average/threshold limit value is 1 ppm (8 mg/m^3), and OSHA's permissible exposure limit is also 1 ppm (8 mg/m^3). No quantitative information concerning an odor threshold is available, but the chemical at concentrations in excess of 1 ppm causes lacrimation and upper respiratory irritation and at 0.4 ppm may cause mild irritation. The National Occupational Exposure Survey, conducted by NIOSH from 1980 to 1983, indicated that 1,445 workers, including 230 women, were potentially exposed to tetranitromethane in 1980. This estimate was based only on observations of the actual use of the compound (NIOSH, 1984).

In 1980, CPSC preliminarily determined that tetranitromethane was not present in consumer products under its jurisdiction. CPSC subsequently requested public comment to verify the accuracy of its information, and no comments were received. Pending the receipt of new information, CPSC plans no action on tetranitromethane. EPA regulates tetranitromethane under the Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and Superfund Amendments and Reauthorization Act (SARA). Tetranitromethane is a toxic pollutant of water. EPA has established water quality criteria for tetranitromethane, effluent guidelines, rules for regulating hazardous spills, general threshold amounts, and requirements for handling and disposal of tetranitromethane wastes. A reportable quantity (RQ) of 1 lb has been established for tetranitromethane under CWA and RCRA. RQ of 10 lb for the tetranitromethane

under CERCLA. Tetranitromethane is regulated as a hazardous constituent of waste under RCRA. OSHA final rule regulates both the permissible exposure limit (PEL) and 8-hr time-weighted average (TWA) to 1 ppm. OSHA regulates tetranitromethane under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table B-139.